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Franck Adoho and Quentin Wodon

World Bank

June 2014

Online at <http://mpra.ub.uni-muenchen.de/56934/>

MPRA Paper No. 56934, posted 29. June 2014 13:43 UTC

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This paper is forthcoming in:

Wodon, Q., A. Liverani, G. Joseph and N. Bougnoux, 2014 editors, *Climate Change and Migration: Evidence from the Middle East and North Africa*, Washington, DC: The World Bank.

Abstract

What are the coping mechanisms and adaptation strategies (apart from migration which is discussed in part III of the study) that households use in order to respond to changes in climate and environmental conditions? Are households forced to sell assets or take other emergency measures in cases of losses due to extreme weather events? Beyond short term emergency responses, are they taking measures to adapt to changing conditions? This paper is based on new household survey data collected in 2011 in Algeria, Egypt, Morocco, Syria, and Yemen, documents the coping and adaptation strategies of households as well as government and community responses to changes in weather patterns and the environment. Overall, the results suggest that coping and adaptation strategies used by households to deal with shocks are diverse, but still limited, as are the community and government responses that could help them.

1. Introduction

Weather and environmental conditions in many areas of the MENA region have worsened in the recent past and are expected to worsen further in the future. This is likely to lead to substantial increases in temperature, reductions in rainfall, and a higher likelihood of extreme weather events such as droughts and floods (Verner, 2011; UNDP 2009; World Bank, 2010; IPCC, 2012; Elasha, 2010; McSweeney, New, and Lizcano, 2009). These trends will exacerbate water scarcity issues and threaten agricultural sectors which remain essential for the livelihood of a substantial share of the population in many countries, and especially in some of the countries analyzed in this study (on the literature, see Wodon et al., 2014, and Burger et al., 2014a).

Using the same household survey data collected in 2011 in Algeria, Egypt, Morocco, Syria, and Yemen, Adoho and Wodon (2014a) suggest that households living in areas exposed to weather shocks indeed do perceive a change in weather patterns and in their environment. Furthermore, a large majority of households declare having lost income, crops, livestock or cattle, or fish due to adverse weather events and changing environmental conditions over the five years preceding the surveys. It was also shown that the poor have paid the highest price in terms of a higher likelihood of losses for the changes that are taking place in the climate.

In this paper the focus is on the coping mechanisms and adaptation strategies used by the households when affected by adverse weather events or changes in their environment. Both the households who declare having been affected by weather shocks and suffered losses and the population as a whole living in the areas where the surveys were implemented are considered. Apart from looking at household specific coping mechanisms and adaptation strategies, data are also provided as to whether communities are promoting adaptation strategies at the local level, and whether the government also provides support for adaptation, as well as for coping among others through the availability of social protection programs that could help households in need.

The structure of the chapter is as follows. Section 2 introduces the data used for the analysis, and especially the main questions in the surveys related to coping and adaptation. Sections 3 and 4 respectively discuss households coping mechanisms and adaptation strategies. Community and government responses are discussed in section 5. A brief conclusion follows.

2. Data and Methodology

As in chapter 5, this chapter relies on data from five household surveys implemented in Algeria, Egypt, Morocco, Syria, and Yemen. In each country, 800 households were interviewed, typically in two main areas per country. A brief description of the areas where the surveys were implemented in each of the countries was provided in chapter 3. The survey questionnaire included a total of 17 sections. This chapter focuses on part of the data collected in section 5 on perceptions related to extreme weather events and climate change, and specifically on the coping mechanisms and adaptation strategies used by households to cope with changing climatic conditions and adverse weather shocks. Data are also provided as to whether communities are promoting adaptation strategies, and whether the government also provides support to do so.

On coping, households who declared that they had experienced a loss of crops, income, livestock or fish due to weather shocks or changes in the environment were asked if they used the following coping strategies: (1) Selling or pawning livestock; (2) Selling or pawning assets other than livestock, such as land or jewelry; (3) Withdrawing children from school; (4) Using their savings; and finally (5) Asking for a loan. In addition, households who did not experience a loss linked to an adverse weather events were asked whether they would rely on the same coping mechanisms in case they would experience such a loss. In that case, households could say that they strongly agree that they would use the coping mechanisms, that they somewhat agree, that

they somewhat disagree, or that they strongly disagree. Statistics will be provided on the reliance on various coping mechanisms for both the households who did experience a loss and for the sample as a whole, including in that case the responses of households to the same question in the case of a hypothetical loss. In addition to the basic statistics, regression analysis will be provided for analyzing the extent to which households who actually experienced a loss (and for whom the information may be more reliable) have used the various coping mechanisms. For the regression analysis, a Heckman probit model is used with a first stage probit regression on the probability of experiencing a loss, and a second stage regression on whether households have relied on the specific coping strategy after the loss. The identification variable for the system is the leave-out-mean probability of experiencing a loss in the area where the household lives, with the area defined as the primary sampling unit of the household in the survey dataset.

On adaptation, households were asked whether they have taken specific actions to adapt to changing weather patterns following losses of crops, income or livestock due to weather or environmental changes. All households answered the question, not only those who declared having suffered losses. The following potential actions that could be taken by households were listed: (1) change in the timing of planting the main crop; (2) change in the source from which the water is drawn; (3) as compared to 5 years ago, longer time to gather or collect water; (4) collecting more firewood; (5) as compared to 5 years ago, longer time to collect firewood; (6) terracing the land; (7) drilling boreholes; (8) change in the production technologies used, such as land preparation, sowing or weeding; (9) change in the crop choices, increase in the crop variety, or adopting draught or flood resistant crops; (10) change in the percentage composition of crops vs. livestock; (11) increase in the use of fertilizer or pesticides; (12) seeking or increasing off-farm employment; (13) receiving occupational training for non-farm employment; (14) using more stored water as compared to five years ago; (15) consuming more stored grains and stored animal products as compared to 5 years ago; (16) being aware of people moving out of the community as a result of weather or environmental changes; (17) in the last five years, having people moved into the community; (18) if people moved into the community, this leading to conflict in the community; (19) in the past five years, having personally experienced a conflict over agricultural land or livestock as a result of weather or environmental changes; and finally (20) in the last 5 years, having personally experienced a conflict over water for household use or cultivation as a result of weather or environmental changes. Simple probit regressions are estimated to look at the correlates of the probability that households use the various strategies.

On community level responses, households were asked whether in order to cope with the loss of crops, income or livestock due to weather or environmental changes, their community had undertaken the following actions: (1) Planting trees or installing soil protection measures; (2) Building banks on rivers, streams or small check banks to reduce flooding; (3) Developing new infrastructure such as boreholes, wells, irrigation or roads; (4) Gathering and disseminating information on measures to reduce the loss of crops, income or livestock; (6) Taking measures to prepare for future disasters like floods or droughts; (7) Taking action to improve market access for agricultural products or handicrafts, etc.; and finally (8) Taking action to purchase seeds, animals or farm equipment. The responses reflect the perception by households as to whether their community has adopted adaptation strategies. Because this provides only community-level information, only summary statistics are provided as opposed to a regression analysis on the correlates at the household level of these perceptions. Correlates of perceptions might be interesting to analyze, but given that many households in the same community will respond in similar way to the questions, the information provided by those correlates may not be that useful.

Finally, on government responses, households were asked whether in order to cope with the loss of crops, income or livestock due to weather or environmental changes, the government had undertaken a number of actions. While some actions are similar to those mentioned in the question on community responses, others refer more to social protection programs. The list of options in the questionnaire was as follows: (1) Planting trees or installing soil protection measures?; (2) Building banks on rivers, streams or small checking banks to reduce flooding; (3) Developing new infrastructure such as building boreholes and canals for irrigation or roads; (4) Providing seeds or fertilizer or fodder for livestock; (5) Providing storage facility for crops; (6) Providing cash or food for work; (7) Distributing cash for food during floods and droughts; (8) Providing drinking water; (9) Providing skills training programs; (10) Providing credit during crop loss; (11) Improving access to markets by providing transportation; and finally (11) Supporting prices when agricultural prices are low. Again, the responses reflect the perception by households as to whether their government has provided support, and not whether they personally have received support. For that reason, as for the community level responses, only summary statistics are provided in the analysis as opposed to regression analysis.

One more point requires a brief explanation regarding the way climatic conditions are treated in the analysis. The survey questionnaire includes a large number of variables on the perceptions of households regarding various changes in weather patterns and their environment. Instead of trying to assess individually the impact of each of those variables on coping mechanisms and adaptation strategies, we rely on two broader indices of household perceptions regarding climatic conditions that were constructed through a multiple correspondence analysis (MCA). The approach used is discussed in chapter 3. What matters for the interpretation in this chapter is that the first factor mostly captures the extent to which households perceive that the climate is becoming dryer and warmer, and it is associated with droughts and the lack of rain. The second factor mostly captures the extent to which households suffer from excess water, and it is associated with floods. Both factors are normalized and take a value between zero and one, with one characterizing the worst conditions in the sample, and zero the best conditions.

3. Household Coping Mechanisms

Table 1 provides basic statistics on how households have dealt or might deal with losses linked to adverse weather events. As mentioned in the previous section, households who were affected by climate and environmental patterns and who lost income, crops, or livestock and cattle, or who caught less fish, were asked whether they used one of several coping mechanism. Their answer had to be “yes” or “no” (or don’t know). The households who did not suffer losses were asked whether they would use the various coping mechanism if they were affected by climate patterns in the future. Households who strongly or somewhat agreed that they would use the mechanisms were codified as likely to use it, and those who somewhat or strongly disagreed were classified as not likely to use the mechanism, so that the information could be dichotomized and compared with the response provided by those affected by shocks. In table 1, the share of households actually using or likely to use the various mechanisms as a proportion of the total population is provided first (the top part of the table factors in those not affected by shocks). The statistics only for the subsample of households actually affected by losses is provided next.

For the population as a whole, 60.6 percent of households declare that they have used or would use their savings in case of a climate shock. This is followed by 46.8 percent of respondents (typically household heads) who have sold or would sell their assets, 46.2 percent who have asked for a loan or would do so, 40.6 percent who have sold or would sell their livestock, and finally 36.4 percent who have withdrawn or would withdraw their children from

school. The proportions of households resorting to these various strategies tend to be higher among lower quintiles (which have fewer other ways to cope), and they are also higher among households declaring that they lost income, crops, or livestock/cattle, or caught less fish, as expected. There are differences between countries, especially regarding the possibility of withdrawing children from school – in Egypt this is not considered by most households. Also, households receiving international remittances, who tend to be better off, are less likely to resort to coping strategies, except using their savings.

The responses for the sub-sample of those actually declaring a loss are fairly similar, which is not surprising given that a majority of household do declare losses, as documented in chapter 3. The main difference is that the reliance of households on the first four coping mechanisms is higher among those actually affected than among the sample as a whole, which could reflect the fact that an actual shock elicits more responses than a hypothetical one, but could also reflect the fact that the households actually affected tend to be poorer, which may require them to rely on such coping mechanisms more, even if many of the mechanisms such as selling livestock or assets, or withdrawing children from school often have adverse long term consequences. In the sample of those affected, the share of those who sold or pawned livestock increases to 42.3 percent, while that of those who sold other assets increases to 54.1 percent. The probability of withdrawing children from school reaches 46.5 percent, and that of using one's savings reaches 78.2 percent. The only case where the reliance on the coping mechanism is lower among those who incurred a loss than among the population as a whole is that of loans, which may again reflect the fact that those affected by losses tend to be poorer and thereby may not have access to credit, whether from friends or relatives or from financial institutions.

Table 1: Household Coping Mechanisms to Deal with Climate Change and Shocks (%)

	Selling or pawning livestock	Selling or pawning other assets	Withdrawing children from school	Using one's savings	Asking for a loan
All households (actual and hypothetical loss)					
All	40.61	46.79	36.42	60.55	46.21
Country					
Algeria	68.96	50.65	60.15	78.42	50.48
Egypt	21.00	20.25	5.13	26.88	13.75
Morocco	41.41	35.26	31.12	46.62	42.04
Syria	33.75	65.50	54.00	90.38	60.25
Yemen	37.94	62.19	31.72	60.45	64.43
Quintiles					
Q1	45.32	53.32	43.44	63.69	45.18
Q2	47.05	54.68	46.37	61.62	47.21
Q3	49.82	54.85	42.66	65.93	47.67
Q4	34.48	38.48	27.92	60.86	48.22
Q5	27.12	33.39	22.45	50.95	42.80
Losses					
Lost income	61.00	69.98	55.70	87.87	63.75
Lost crops	76.06	69.54	59.88	86.22	65.06
Lost livestock or cattle	80.35	69.16	57.01	83.99	71.40
Less fish caught	71.47	72.87	51.27	80.04	72.60
Receives remittances					
Local remittances	57.90	65.71	61.99	79.77	45.09
International remittances	34.73	58.02	47.61	78.34	53.01
Households with an actual loss only					
All	42.30	54.09	46.47	78.22	42.57
Country					
Algeria	75.84	61.19	79.13	77.69	35.18
Egypt	17.13	26.29	10.36	79.68	27.09
Morocco	55.01	54.39	50.81	89.41	61.72
Syria	30.05	68.39	50.68	96.19	43.05
Yemen	27.01	41.03	21.54	48.21	43.25
Quintiles					
Q1	46.65	60.16	51.33	78.88	40.17
Q2	49.83	61.26	53.61	81.53	45.89
Q3	44.21	54.36	49.46	75.11	44.46
Q4	35.39	42.30	37.02	79.45	41.12
Q5	31.36	49.69	36.96	75.62	40.27
Losses					
Lost income	43.00	56.62	47.02	81.10	43.26
Lost crops	55.37	56.08	51.18	76.51	45.18
Lost livestock or cattle	60.19	53.96	46.79	74.01	48.84
Less fish caught	47.23	51.20	37.82	70.95	50.75
Receives remittances					
Local remittances	54.91	61.74	66.41	78.60	31.83
International remittances	30.80	58.36	49.23	83.68	41.88

Source: Authors' estimation.

What about the correlates of the use of various coping mechanisms among the subset of households actually affected by a shock for which the information is likely to be more reliable than for the population as a whole? Table 2 provides the results of Heckman probit models (the first stage probits on the probability of experiencing a loss are not shown; they are very similar to the regressions presented in chapter 3). Country effects are still at work, but one interesting fact is that among those affected by shocks, the likelihood of using various mechanisms is not affected much by the quintile of wealth of the household (remember however that poorer households are often more likely to be exposed to losses due to adverse weather events). On the other hand, households in areas characterized by worsening droughts tend to be more likely to have to sell assets, while by contrast the impact of worsening floods (the second factor in the MCA analysis) is only marginally statistically significant. Thus, apart from causing losses, droughts and the lack of rain are likely to have further negative consequences for households by inducing them to sell assets, while this is not observed to the same extent for floods.

Another finding is that some types of losses increase the likelihood that households will rely on coping mechanisms. Income losses are associated with a higher probability of relying on all coping mechanisms, while a loss in crops is associated with a statistically higher probability of relying on coping mechanisms in only three cases – selling or pawning livestock, selling or pawning other assets, and using one's savings. A loss of livestock or cattle is associated with a likelihood of relying on two mechanisms – selling or pawning livestock and using one's savings. Catching less fish does not lead to a reliance on the various coping mechanisms.

Land owners and tenants are more likely to have to sell livestock or ask for loans, but less likely to withdraw their children from school. Understanding this difference in behavior regarding schooling would require a more detailed analysis, but a possibility might be that children from land owners and tenants might already be less likely to go to school, because of the necessity to work the land, but at this stage of the analysis this is only a conjecture. While the gender of the household head does not make much of a difference in terms of the coping mechanisms used, the education of the head does make a difference, with households with less well educated heads less likely to withdraw children from school, perhaps again because the children are already less likely to be in school. On the other hand, some of the occupations associated with lower earnings are also associated with a higher likelihood of withdrawing children from school. Instead of reaching a conclusion here on these patterns of withdrawal of children to school, a more detailed analysis of schooling patterns (who is enrolled in what grade, for example) would be required before reaching conclusion on that specific coping mechanism.

Households benefitting from remittances are less likely to ask for a loan, probably because they already receive some cash in hand thanks to the transfers that they receive from friends or relatives who migrated. Households with younger heads are less likely to sell assets or use their savings, and more likely to ask for loans. This might be because they have fewer assets that they can sell or savings that they can use in times of difficulties because they have had less time to accumulate those, which then forces them to ask for loans, while households with holder heads have more options apart from loans. Households with a head self-employed as a farmer are less likely to sell other assets, to use one's savings, or to ask for loans, perhaps because the ability of those households to do so is limited given their low earnings and accumulation potential or ability to repay loans. The lower likelihood of asking for loans is also observed for the self-employed in other sectors and servants as well as unqualified workers. Those working in fisheries or pastoral activities are on the other hand more likely to sell livestock, as expected. Finally, households with a head in the public sector are less likely to sell livestock or other assets, possibly because many do not have livestock to sell, and may also not need to sell assets.

Table 2: Correlates of the Coping Mechanisms Used by Households (dF/dX)

	Selling or pawning livestock	Selling or pawning other assets	Withdrawing children from school	Using one's savings	Asking for a loan
Countries (ref.= Algeria)					
Egypt	-0.442***	-0.266***	-0.419***	0.039	-0.148**
Morocco	-0.282***	-0.157***	-0.281***	0.108**	0.084*
Syria	-0.405***	-0.170***	-0.339***	0.324***	-0.030
Yemen	-0.461***	-0.275***	-0.387***	-0.316***	-0.005
Climatic conditions					
Factor 1: Dryer/Warmer Weather	0.444***	0.257***	0.002	0.075	0.027
Factor 2: Excess Water	-0.125*	-0.091	0.118**	0.031	0.155**
Losses (ref.=No loss)					
Income	0.151***	0.118***	0.046*	0.228***	0.118***
Crops	0.183***	0.065**	0.017	0.098**	0.029
Livestock/cattle	0.196***	-0.008	0.014	-0.022	0.049**
Fish	-0.033	-0.005	0.012	0.052	-0.022
Wealth quintiles (ref.=Q5)					
Q1	-0.042	0.038	0.021	-0.038	-0.004
Q2	0.036	0.019	0.032	-0.043	0.027
Q3	-0.022	-0.034	0.013	-0.088**	0.024
Q4	-0.036	-0.067*	-0.010	-0.036	-0.001
Land status (ref.=Neither)					
Land owners	0.234***	0.001	-0.064**	0.082*	0.098***
Land tenants	0.171***	0.064	-0.050	0.157**	0.152***
Remittances					
Receives remittance	-0.017	-0.035	-0.015	-0.002	-0.081**
Age of head (ref.=50+)					
Less than 30	-0.118**	0.014	-0.012	-0.148**	0.118**
30-39	-0.088**	-0.055*	-0.030	-0.090**	0.127***
40-49	-0.114***	-0.059**	-0.045**	-0.022	0.094***
Gender					
Head is a Male	-0.147*	-0.017	0.034	-0.054	0.022
Education of head (ref.=None)					
Primary	0.027	0.045	-0.072**	0.054	-0.062*
Preparatory	-0.006	-0.006	-0.084*	0.025	-0.097**
Secondary	-0.028	0.040	-0.105**	-0.008	-0.052
Above Secondary	-0.101	0.095	-0.025	-0.075	-0.043
Head occupation (ref.=Salaried)					
Self-Employed Farmer	-0.065	-0.117***	0.040	-0.137***	-0.229***
Non-Agric Self Employed	-0.100	-0.070	-0.032	-0.035	-0.189***
Other Employer	-0.097	0.047	0.063	0.017	-0.037
Servant/Unqualified	-0.004	0.011	0.116*	0.103	-0.106*
Other	0.072	0.014	0.097	0.123	-0.025
Agriculture/Fisheries/Pastoral	0.121*	0.054	0.072	0.036	-0.078
Head public employee (ref.=No)					
Head is public employee	-0.148***	-0.127***	-0.035	-0.042	-0.020
Observations	3,004	2,995	3,009	2,976	3,000

Source: Authors' estimation.

4. Household Adaptation Strategies

Households were also asked about actions that they took or might take to cope with the loss of crops, income or livestock due to weather or environmental changes. The possibilities included: changing production technologies such as land preparation, sowing or weeding; changing crop choices, increasing crop variety, or adopting drought or flood resistant crops; changing the percentage composition of crops versus livestock; increasing the use of fertilizer or pesticides; seeking or increasing off-farm employment; and receiving occupational training for non-farm employment. Households were also asked whether compared to five years ago, they used more stored water or consumed more stored grains and stored animal products. They were asked whether they were aware of people moving out of their community as a result of weather or environmental changes, and whether in the last five years people moved into their community. Finally, they were asked if in the past 5 years they experienced conflict over agricultural land or livestock, or water for household use or cultivation due to weather or environmental changes.

The results for those questions and most of the options available in the questionnaire are provided in table 3. For the sample as a whole, and for most of the alternatives presented in the questionnaire, only a minority of households have implemented any single one of the adaptation strategies. This is explained in part by the fact that many of the alternatives apply mostly to farming households, and not all households are involved in farming (this is evident in the fact that the proportion of households using the various adaptation strategies are higher among households who own land, many of whom farm their land). Between one in four and one in five households have relied more on stored grains/products and stored water, have sought off-farm work, have used more fertilizers or pesticides, or have made a change in their farm production technology. The proportion of those who have received training or changed their crop mix or the varieties they use is at about 15 percent. Only nine percent of households have changed their mix of crops and livestock for their livelihood.

On the other hand, more than four in ten households say that they know people who have moved out of their community due to the climate pressures, and 14 percent declare that some people have moved in, which may at time generate conflict over water, land, or livestock. There are some large differences between countries in the use of adaptation strategies, with households in Egypt and Syria making fewer changes in their modes of livelihood than households in Algeria, Yemen, and to some extent Morocco. It also appears that households in the bottom quintiles, which tend to be affected by climate change the most and have limited means to cope with weather shocks and changing conditions, also have made more changes in their livelihood strategies. But this may also be in part because a larger share of those households is involved in farming. As before households with international remittances who tend to also be better off tend to rely less on those adaptation strategies than other households.

Table 3: Household Adaptation Strategies to Deal with Climate Change and Shocks (%)

	Change in production technology	Change in crops mix, varieties	Change crops vs. livestock	More Fertilizers, pesticides	Seeking non-farm work	Training for non- farm work
All	19.35	15.53	8.89	21.12	22.67	15.09
Country						
Algeria	48.61	42.45	15.25	42.16	57.04	43.30
Egypt	2.13	4.50	2.50	4.63	4.13	4.00
Morocco	21.43	16.04	8.93	31.47	25.33	1.67
Syria	5.38	4.38	3.38	5.88	1.13	2.00
Yemen	21.95	12.94	15.10	23.48	29.06	27.28
Quintiles						
Q1	31.50	27.92	10.36	22.65	27.57	24.37
Q2	25.42	17.84	11.45	22.35	24.33	18.34
Q3	20.84	19.35	13.21	22.49	24.21	17.00
Q4	10.09	7.51	5.12	22.43	20.64	9.24
Q5	8.65	4.73	4.30	15.46	16.42	6.23
Losses						
Lost income	26.19	22.24	12.55	24.02	26.63	19.86
Lost crops	41.65	34.89	17.04	38.33	39.25	29.77
Lost livestock or cattle	32.67	26.84	19.39	36.54	28.87	23.79
Less fish caught	32.58	27.03	24.48	39.63	30.60	23.55
Receives remittances						
Local remittances	40.66	35.10	15.91	27.47	40.78	35.86
International remittances	12.62	12.23	13.95	14.98	14.96	10.64
Land ownership						
Land owners	43.42	35.10	16.71	45.66	41.51	29.08
Land tenants	15.15	13.52	14.25	20.98	22.44	11.06
No land cultivated or owned	5.05	3.76	3.53	6.10	11.15	6.93
	Use of stored water	Stored grains/ products	People moving out	People moving in	Conflict (land, livestock)	Conflict (water)
All	20.54	28.37	40.29	13.99	12.85	8.35
Country						
Algeria	32.08	41.63	17.92	20.46	44.05	11.93
Egypt	15.00	13.00	20.38	8.13	1.00	1.13
Morocco	6.54	38.42	48.76	18.26	5.01	8.02
Syria	12.75	17.00	85.25	2.63	0.38	1.00
Yemen	37.69	33.12	26.96	21.14	16.58	20.18
Quintiles						
Q1	20.29	36.94	36.85	14.81	20.58	7.40
Q2	25.24	33.77	42.41	13.86	16.55	9.63
Q3	21.93	30.79	47.06	15.40	19.02	11.19
Q4	18.30	23.90	37.87	13.88	4.26	7.37
Q5	16.89	16.06	37.37	11.99	3.76	6.17
Losses						
Lost income	23.34	36.90	50.59	14.02	19.29	11.01
Lost crops	31.74	52.98	40.20	17.89	29.52	15.95
Lost livestock or cattle	32.28	45.32	47.93	22.72	21.85	18.91
Less fish caught	35.48	56.53	45.81	19.11	22.49	24.27
Receives remittances						
Local remittances	28.55	46.14	46.13	14.57	37.30	19.70
International remittances	19.92	23.55	68.38	14.35	6.93	13.62
Land ownership						
Land owners	29.55	49.69	37.67	17.20	29.43	15.19
Land tenants	26.79	30.26	33.67	9.37	5.09	3.45
No land cultivated or owned	14.36	15.10	42.60	12.53	3.53	4.69

Source: Authors' estimation.

In a similar way to the analysis presented in the previous section on the correlates of coping mechanisms, an analysis of the correlates of the adaptation strategies used by households can be provided. This is done in table 4 with probit models for the main adaptation strategies. As for coping mechanisms, country effects are still at work, but among those affected by shocks, and in many cases the likelihood of using various adaptation strategies does not seem to be affected by the quintile of wealth of the household. There are exceptions though, with statistical significance in the case of the first quintile, as compared to the reference category of the top quintile. In many cases, the poorest households are more likely to use adaptation strategies, probably because they are also those affected the most by climate change, as documented in chapter 3. But in a few cases, households in the bottom quintile are less likely to adopt a strategy, and this is especially the case for terracing the land, increasing the use of pesticides and fertilizers, and (knowing people who are) moving out, three options that are often costly and may therefore be out of reach for the very poor (the fact that the very poor are less likely to witness conflict over water could possibly signal their lack of access or property rights over water).

As for coping mechanisms, households in areas characterized by worsening droughts are more likely to use most of the adaptation strategies listed, which makes sense given that they are more affected by adverse weather events. Apart from a few coefficients that are not statistically significant, the only exception is for terracing the land, which may again denote the cost of the option and may not be very effective against droughts. In addition, and this is different from what was observed for coping mechanisms, households more affected by floods and associated conditions are also more likely to rely on adaptation strategies. The only exception is the reliance on stored water, which is clearly not needed when suffering from an excess of water.

What about the impact of the type of loss suffered, when such loss was incurred? As for coping mechanisms, income losses tend to be associated with a higher probability of using many of the adaptation strategies when the effects are strongly statistically significant, at least at the five percent level. Similarly, all strongly statistically significant effects for the loss of crops indicate a higher use of adaptation strategies. For livestock, the effects are more varied, with a higher use of some adaptation strategies and a lower use of others.

Land owners are also more likely to use the various adaptation strategies. This is again as expected given that they tend to be more affected by adverse weather events. The same is observed for land tenants, but to a slightly lower extent in terms of the magnitude of the coefficients, their statistical significance, and some cases with opposite effects (for people moving out and conflicts over water, although the second effect is only marginally significant.)

There are also some statistically significant effects in terms of the characteristics of the household head according to age, gender, marital status, education, and occupation, but these are more the exceptions as opposed to the rule given that many coefficients are not statistically significant. Still, households with younger heads are less likely to use many of the adaptation strategies, whether this is because they have fewer means to do so or because they have other options, including that of migration which is often undertaken by younger individuals. Households with a head working as a public employee are also less likely to have to resort to many of the adaptation strategies, the only positive and statistically significant effect being that of the use of fertilizers and pesticides, which is likely to be more affordable to them. Another result which was to be expected is that farmers are also more likely to rely on some of the strategies. What these results suggest is that even though overall the likelihood of using the various adaptation strategies is low in the sample, it is higher for those households who needs such strategies the most, both because of their occupation (in agriculture) and because of their exposure to shocks as captured by the two factors reflecting changes in weather conditions.

Table 4: Correlates of the Use of Adaptation Strategies by Households (dF/dX)

	Change in time of planting	Change in water source	More time to gather water	Collecting more firewood	More time to collect firewood	Terracing the land
Countries (ref.= Algeria)						
Egypt	-0.117***	-0.020	-0.054*	-0.257***	-0.214***	-0.153***
Morocco	-0.116***	-0.078***	-0.076***	-0.064***	-0.118***	0.045**
Syria	-0.114***	-0.091***	-0.100***	-0.233***	-0.238***	-0.030
Yemen	-0.040**	0.154***	0.206***	0.001	-0.072***	0.113***
Climatic conditions						
Factor 1: Dryer/Warmer Weather	0.166***	0.102***	0.194***	0.164***	0.305***	-0.105***
Factor 2: Excess Water	0.007	0.113***	0.161***	0.097**	0.143***	0.099***
Losses (ref.=No loss)						
Income	0.122***	-0.000	0.086***	0.095***	0.107***	0.040**
Crops	0.009	0.019	0.037*	0.120***	0.072***	-0.022
Livestock/cattle	-0.004	0.046***	0.167***	-0.024	-0.036**	0.078***
Fish	0.026	-0.031**	-0.056**	0.057*	0.061*	0.080***
Wealth quintiles (ref.=Q5)						
Q1	0.071**	-0.017	-0.050*	0.065**	0.099***	-0.039**
Q2	0.009	0.020	0.034	0.042	0.007	0.014
Q3	0.001	-0.008	0.041	0.063**	0.056*	-0.022
Q4	0.024	-0.018	0.059*	-0.005	0.054*	0.030
Land status (ref.=Neither)						
Land owners	0.097***	0.074***	0.054**	0.076***	0.058***	0.132***
Land tenants	0.015	0.145***	0.106**	0.105***	-0.003	0.136***
Age of head (ref.=50+)						
Less than 30	-0.030	-0.034	-0.097***	-0.034	-0.113***	0.005
30-39	-0.011	-0.025*	-0.018	-0.020	-0.072***	0.030
40-49	-0.018	-0.003	-0.033*	-0.035*	-0.055***	0.048***
Gender of head (ref.=Female)						
Male	-0.015	0.046	0.020	-0.134*	-0.180**	-0.006
Status of head (ref.=Other)						
Single	-0.050	0.010	0.044	0.032	0.115	0.017
Married	0.014	0.013	0.006	0.081*	0.078*	0.004
Education of head (ref.=None)						
Primary	-0.019	-0.023	0.036	-0.004	-0.008	-0.006
Preparatory	-0.038*	-0.020	0.023	-0.017	-0.063**	0.022
Secondary	-0.020	-0.008	-0.016	-0.078***	-0.068**	-0.045**
Above Secondary	-0.002	-0.021	-0.004	-0.094***	0.001	-0.018
Head public employee (ref.=No)						
Head is public employee	-0.061***	-0.032**	-0.069***	-0.059**	-0.104***	0.001
Head occupation (ref.=Salaried)						
Self-Employed Farmer	0.091***	0.043*	0.020	0.046	0.031	0.116***
Non-Agric Self Employed	0.021	0.008	-0.030	0.004	-0.021	0.085**
Other Employer	0.045	0.029	0.057	0.095**	0.051	0.091***
Servant/Unqualified	0.008	0.063*	0.072*	0.053	0.044	0.048
Other	0.017	-0.004	-0.022	0.024	-0.011	-0.048*
Agriculture/Fisheries/Pastoral	0.058	-0.023	-0.022	0.130***	0.107**	0.046
Number of observations	2,936	2,927	2,930	2,929	2,926	2,928

Source: Authors' estimation.

Table 4 (cont.): Correlates of the Use of Adaptation Strategies by Households (dF/dX)

	Drilled boreholes	Changed production technology	Changed crops	Changed crop share vs livestock	Increased use of fertilizer or pesticides	Sought or increased off-farm work
Countries (ref.= Algeria)						
Egypt	-0.171***	-0.164***	-0.075***	-0.023	-0.166***	-0.262***
Morocco	-0.118***	-0.167***	-0.125***	-0.058***	-0.074***	-0.201***
Syria	-0.120***	-0.173***	-0.129***	-0.077***	-0.153***	-0.292***
Yemen	-0.079***	-0.088***	-0.080***	0.008	-0.027	-0.162***
Climatic conditions						
Factor 1: Dryer/Warmer Weather	0.020	0.145***	0.168***	0.102***	0.057	0.189***
Factor 2: Excess Water	0.162***	0.071**	0.037	0.113***	0.302***	0.019
Losses (ref.=No loss)						
Income	-0.029*	0.124***	0.137***	-0.017	0.051**	0.054**
Crops	-0.027*	0.022	-0.000	0.035***	-0.014	0.086***
Livestock/cattle	0.030**	-0.013	-0.008	0.029**	0.013	-0.113***
Fish	0.029	-0.001	0.013	0.055**	0.004	0.006
Wealth quintiles (ref.=Q5)						
Q1	0.007	0.122***	0.190***	0.016	-0.066***	0.020
Q2	0.004	0.068**	0.060**	0.026	-0.060***	-0.007
Q3	0.038	0.003	0.067**	0.024	-0.038*	0.013
Q4	-0.002	0.011	0.042	-0.012	-0.008	0.033
Land status (ref.=Neither)						
Land owners	0.116***	0.190***	0.133***	0.054***	0.273***	0.111***
Land tenants	0.073*	0.074*	0.091**	0.146***	0.197***	0.092**
Age of head (ref.=50+)						
Less than 30	-0.033	0.021	0.050	-0.010	-0.060**	-0.098***
30-39	-0.019	-0.011	0.015	0.025*	-0.020	-0.010
40-49	-0.014	-0.001	0.016	0.025**	0.013	0.017
Gender of head (ref.=Female)						
Male	0.060**	0.040	0.003	-0.004	0.073*	0.039
Status of head (ref.=Other)						
Single	-0.055	-0.095**	-0.032	0.004	-0.028	0.004
Married	-0.030	-0.080	-0.041	-0.016	-0.012	-0.058
Education of head (ref.=None)						
Primary	-0.008	0.019	-0.019	-0.002	0.031	-0.099***
Preparatory	-0.049**	-0.107***	-0.033	-0.028*	0.087**	-0.043
Secondary	0.022	-0.007	-0.019	0.025	0.108***	-0.005
Above Secondary	0.040	0.001	0.014	0.019	0.070	-0.002
Head public employee (ref.=No)						
Head is public employee	-0.018	-0.031	-0.049**	-0.002	0.072**	-0.016
Head occupation (ref.=Salaried)						
Self-Employed Farmer	-0.002	0.040	0.060**	0.041**	0.039	-0.093***
Non-Agric Self Employed	0.036	0.055	-0.008	0.031	0.192***	-0.052*
Other Employer	0.085**	0.078*	0.041	0.001	0.046	-0.083***
Servant/Unqualified	-0.061***	0.018	0.131***	0.044	0.062	-0.065*
Other	-0.033	-0.036	-0.009	0.003	-0.057	-0.127***
Agriculture/Fisheries/Pastoral	0.022	0.091**	0.129***	0.030	0.066*	0.020
Number of observations	2,925	2,929	2,925	2,926	2,926	2,926

Source: Authors' estimation.

Table 4 (cont.): Correlates of the Use of Adaptation Strategies by Households (dF/dX)

	Training for non- farm work	Used more stored water	Consumed more stored food	People moving out	Any type of conflict	Conflict over water
Countries (ref.= Algeria)						
Egypt	-0.094***	-0.007	0.105**	0.191***	-0.090***	-0.048***
Morocco	-0.210***	-0.203***	0.019	0.269***	-0.120***	-0.047***
Syria	-0.135***	-0.090***	-0.153***	0.594***	-0.108***	-0.076***
Yemen	-0.025*	0.103***	0.061*	0.111***	-0.067***	0.071***
Climatic conditions						
Factor 1: Dryer/Warmer Weather	0.174***	0.103***	0.334***	0.215***	0.132***	0.032
Factor 2: Excess Water	0.129***	-0.086**	0.058	0.223***	-0.042*	0.106***
Losses (ref.=No loss)						
Income	0.061***	0.090***	0.235***	-0.046*	0.056***	0.010
Crops	-0.006	-0.012	0.047*	0.077***	0.028**	0.012
Livestock/cattle	-0.028**	0.044**	-0.025	0.126***	-0.024***	0.035***
Fish	0.002	0.053	0.059	-0.029	0.035*	0.000
Wealth quintiles (ref.=Q5)						
Q1	0.122***	-0.039	0.114***	-0.115***	0.097***	-0.026**
Q2	0.067**	0.034	0.123***	-0.011	0.069**	-0.015
Q3	0.034	0.006	0.068*	0.047	0.121***	-0.006
Q4	0.054**	-0.030	0.120***	-0.011	0.017	0.001
Land status (ref.=Neither)						
Land owners	0.067***	0.122***	0.173***	0.057**	0.047***	0.034***
Land tenants	0.021	0.167***	0.135***	-0.087**	-0.019	-0.026*
Age of head (ref.=50+)						
Less than 30	-0.035*	-0.051*	-0.002	-0.096**	-0.036**	-0.037***
30-39	-0.004	-0.006	0.008	-0.079***	-0.027***	-0.026***
40-49	-0.000	0.027	0.003	0.012	-0.014	-0.011
Gender of head (ref.=Female)						
Male	-0.066	0.099***	0.078	0.038	-0.074	0.008
Status of head (ref.=Other)						
Single	-0.028	-0.061	-0.145**	0.106	0.051	-0.015
Married	-0.000	0.004	-0.120	0.015	0.024	-0.027
Education of head (ref.=None)						
Primary	-0.027	0.076***	-0.016	-0.005	-0.028**	-0.012
Preparatory	-0.026	0.071**	-0.051	-0.035	-0.008	-0.017
Secondary	0.027	0.085**	0.019	0.072*	-0.007	-0.007
Above Secondary	0.043	0.078*	-0.035	-0.053	0.015	-0.008
Head public employee (ref.=No)						
Head is public employee	-0.022	-0.015	-0.050	-0.047	-0.048***	-0.023**
Head occupation (ref.=Salaried)						
Self-Employed Farmer	0.005	0.001	0.093***	-0.031	-0.001	-0.003
Non-Agric Self Employed	-0.014	0.030	0.037	0.001	0.007	0.001
Other Employer	-0.021	-0.039	0.029	0.052	0.067*	0.041*
Servant/Unqualified	0.092**	0.010	0.142***	-0.006	0.037	0.107***
Other	-0.071***	-0.045	0.134**	-0.050	-0.038**	-0.003
Agriculture/Fisheries/Pastoral	0.019	-0.002	0.031	0.030	0.043	0.042
Number of observations	2,926	2,926	2,926	2,929	2,933	2,931

Source: Authors' estimation.

5. Community Level and Government Responses

In the previous two sections, information was provided about ways in which households cope with or adapt to weather or environmental changes. What about the role of communities and governments? As mentioned in section 2, the survey questionnaire asked households whether to cope with the loss of crops, income or livestock due to weather or environmental changes, the communities in which the household live implemented a number of initiatives. Table 5 provides basic statistics on the shares of households declaring that this was indeed the case. Overall, the data suggest that the extent of community involvement to adapt to climate change is rather limited. While one in five households declares that the community has planted trees or taken soil erosion measures, and one in seven households mentioned community measures to purchase seeds, animals or farm equipment, the other actions that could be taken by communities are mentioned by only one in ten households on average. There are large differences between countries, with households in Algeria and Yemen much more likely to mention community initiatives than households in the other three countries. Households in the bottom quintiles (as well as those owning land although this is not shown in the table) are also more likely to mention initiatives, perhaps because they are more aware of these initiatives as they tend to be affected by weather shocks more. Still, many communities do not seem to implement the types of measures that might help households to cope and adapt.

Table 5: Community Level Response to Deal with Climate Change and Shocks (%)

	Planting trees and soil protection	Banks against flooding	Boreholes, wells, irrigation, roads	Information on how to reduce losses	Preparation for future disasters	Market access for products	Seeds, animals, and farm equipment
All Country	19.06	11.41	10.19	7.90	10.15	10.47	14.58
Algeria	47.62	38.40	21.02	14.27	32.40	21.84	39.88
Egypt	4.88	1.63	2.38	8.25	3.13	7.13	8.13
Morocco	2.53	3.43	4.09	1.97	2.18	4.96	4.22
Syria	14.63	1.63	4.13	2.00	1.50	0.88	1.50
Yemen	26.72	12.98	19.73	13.23	12.36	17.98	20.10
Quintiles							
Q1	30.53	23.07	10.31	7.28	19.40	11.71	19.38
Q2	23.26	15.78	10.59	10.15	13.92	13.20	17.45
Q3	21.45	12.40	16.69	13.52	11.77	15.54	22.55
Q4	10.91	3.36	6.36	5.52	2.44	8.52	8.91
Q5	9.33	2.58	7.28	3.25	3.37	3.56	4.92
No land cultivated/owned	11.64	5.02	7.16	5.50	4.78	5.63	7.15

Source: Authors' estimation.

Similar questions were asked about the role of governments, albeit as mentioned in section 2 with slightly different modalities, including more transfers and social protection programs, such as cash or food for work programs, cash for food during floods and droughts, as well as the provision of drinking water, the provision of skills training programs, the provision of credit during crop loss, improvements in access to markets through transportation, and price support for crops when agricultural prices are low. The results are provided in table 6. Except for the provision of drinking water which is less related to climate change and shocks, the extent of government involvement in adaptation strategies or safety nets is also limited. For most types of programs, only about one in ten households declare that the government has been active. There are again differences between countries, with households in Algeria, Syria, and Yemen more

likely to mention government programs than households in Egypt and Morocco. In many but not in all cases households in the bottom three quintiles are more likely to mention initiatives, as was the case for community programs. Overall, as was the case for community-level responses, the extent of government support also appears to be rather limited.

Table 6: Government Response to Deal with Climate Change and Shocks (%)

	Planting trees and soil protection	Banks against flooding	Boreholes, wells, irrigation, roads	Seeds, fertilizers, or fodder for livestock	Storage facility for crops	Cash or food for work programs
All	12.36	10.57	14.98	13.35	10.41	9.93
Country						
Algeria	19.30	16.46	19.78	19.19	17.17	14.69
Egypt	8.25	5.00	4.63	6.38	4.88	7.38
Morocco	6.00	5.00	6.19	8.31	2.04	1.13
Syria	10.75	10.88	21.88	23.88	21.38	18.13
Yemen	17.75	15.75	22.60	9.24	6.87	8.49
Quintiles						
Q1	13.32	11.79	15.18	14.62	9.71	8.48
Q2	12.99	11.41	13.17	13.19	12.33	14.73
Q3	15.27	13.94	19.79	20.30	17.26	11.66
Q4	9.25	7.66	12.76	10.58	7.34	7.65
Q5	11.12	8.23	14.20	8.33	5.71	7.23
	Cash for food during floods and droughts	Provision of drinking water	Provision of skills training programs	Provision of credit during crop loss	Improved access to markets, transport	Price support prices when agricultural prices are low
All	10.08	24.67	6.65	11.98	10.33	10.10
Country						
Algeria	16.67	27.82	11.12	38.21	14.90	18.80
Egypt	7.38	7.38	4.38	5.75	6.63	8.00
Morocco	2.37	29.31	0.70	4.67	4.80	1.94
Syria	13.88	30.75	2.88	4.38	10.75	15.38
Yemen	10.36	28.21	14.36	7.87	14.73	6.74
Quintiles						
Q1	10.41	19.93	7.03	23.61	10.81	12.49
Q2	13.27	22.32	8.16	17.26	11.09	8.54
Q3	14.73	26.91	8.48	11.87	15.91	17.25
Q4	5.69	25.57	5.36	4.55	8.15	7.54
Q5	6.55	28.72	4.31	2.68	5.90	4.95

Source: Authors' estimation.

6. Conclusion

The goal of this chapter was to contribute to a better understanding of how households cope with and adapt to changing climatic conditions in the MENA region. The analysis of new household survey data from five countries suggests that while changes in weather patterns and the environment of households have affected a large majority of households, the coping mechanisms and adaptation strategies used by households to deal with those shocks are limited.

Many households appear to have to sell livestock or other assets when affected by adverse weather events, and a large share also appears to be withdrawing children from school. The ability to ask for loans seems to be limited in the bottom quintiles, while savings can be quickly exhausted. These coping mechanisms, while necessary in the short term, may put at risk the ability of households to increase their earnings in the future, including for the children.

Furthermore, while the likelihood of using various adaptation strategies is higher among the most affected households, virtually all the adaptation strategies are implemented only by a small minority of households. This suggests that while adaptation is taking place, it may not be taking place at the level that the deteriorating climatic conditions appear to call for. Finally, the extent to which households benefit from community level and government programs and initiatives to help them cope with and adapt to weather and environmental changes is limited.

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